

System of Equations Worksheet

Substitution Study Guide

Example 1

Solve using substitution

$$x = 4y$$

$$2x - y = 14$$

Since $x = 4y$, substitute it in for x in the second equation.

$$2(\quad) - y = 14$$

$$2(4y) - y = 14$$

$$8y - y = 14$$

$$7y = 14$$

$$\frac{7}{7} = \frac{14}{7}$$

$$y = 2$$

Back substitute to find x .

$$x = 4y$$

$$x = 4(2)$$

$$x = 8$$

The solution is $(8, 2)$.

Example 2

Solve using substitution

$$x - 3y = 9$$

$$4x + 2y = 26$$

Solve the first equation for x since the coefficient of x is 1.

$$x - 3y = 9$$

$$\frac{+3y}{+3y} \quad \frac{+3y}{+3y}$$

$$x = 3y + 9$$

Since $x = 3y + 9$, substitute it in for x in the second equation.

$$4(\quad) + 2y = 26$$

$$2(3y + 9) + 2y = 26$$

$$6y + 18 + 2y = 26$$

$$6y + 2y + 18 = 26$$

$$8y + 18 = 26$$

$$\frac{-18}{-18} \quad \frac{-18}{-18}$$

$$8y = 8$$

$$\frac{8}{8} = \frac{8}{8}$$

$$y = 1$$

Back substitute to find y .

$$4x + 2y = 26$$

$$4x + 2(1) = 26$$

$$4x + 2 = 26$$

$$\frac{-2}{-2} \quad \frac{-2}{-2}$$

$$4x = 24$$

$$\frac{4}{4} = \frac{24}{4}$$

$$x = 6$$

The solution is $(6, 1)$.

$$1. \begin{cases} y = -2x + 3 \\ x - y = 3 \end{cases}$$

$$2. \begin{cases} 2x - y = 1 \\ x = -3y + 4 \end{cases}$$

$$3. \begin{cases} x = 3y + 3 \\ 2x - 6y = 12 \end{cases}$$

$$4. \begin{cases} 3x + 4y = 18 \\ 2x - y = 1 \end{cases}$$

$$5. \begin{cases} y = -\frac{4}{3}x + 6 \\ y = 2 \end{cases}$$

$$6. \begin{cases} 7x + 3y = -16 \\ x - 2y = 5 \end{cases}$$

$$7. \begin{cases} 3x - y = 4 \\ 6x - 2y = 8 \end{cases}$$

$$8. \begin{cases} 8x + y = 31 \\ x = -3 - 7y \end{cases}$$

$$9. \begin{cases} 2x + y = 42 \\ x = 10y \end{cases}$$

$$10. \begin{cases} 3x + 4y = 19 \\ 3x + 6y = 33 \end{cases}$$

System of Equations Worksheet

Substitution Solutions

$$1. \begin{aligned} y &= -2x + 3 \\ x - y &= 3 \end{aligned}$$

$$\begin{aligned} x - () &= 3 \\ x - (-2x + 3) &= 3 \\ x + 2x - 3 &= 3 \\ 3x - 3 &= 3 \\ \underline{+3} \quad \underline{+3} \\ 3x &= 6 \\ \underline{3} \quad \underline{3} \\ x &= 2 \end{aligned}$$

$$\begin{aligned} y &= -2() + 3 \\ y &= -2(2) + 3 \\ y &= -4 + 3 \\ y &= -1 \end{aligned}$$

$$(2, -1)$$

$$2. \begin{aligned} 2x - y &= 1 \\ x &= -3y + 4 \end{aligned}$$

$$\begin{aligned} 2() - y &= 1 \\ 2(-3y + 4) - y &= 1 \\ -6y + 8 - y &= 1 \\ -6y - y + 8 &= 1 \\ -7y + 8 &= 1 \\ \underline{-8} \quad \underline{-8} \\ -7y &= -7 \\ \underline{-7} \quad \underline{-7} \\ y &= 1 \end{aligned}$$

$$\begin{aligned} x &= -3() + 4 \\ x &= -3(1) + 4 \\ x &= -3 + 4 \\ x &= 1 \end{aligned}$$

$$(1, 1)$$

$$3. \begin{aligned} x &= 3y + 3 \\ 2x - 6y &= 12 \end{aligned}$$

$$\begin{aligned} 2() - 6y &= 12 \\ 2(3y + 3) - 6y &= 12 \\ 6y + 6 - 6y &= 12 \\ 6y - 6y + 6 &= 12 \\ 0y + 6 &= 12 \\ 6 &\neq 12 \end{aligned}$$

Inconsistent.
The lines are parallel.

$$4. \begin{aligned} 3x + 4y &= 18 \\ 2x - y &= 1 \end{aligned}$$

$$\begin{aligned} 2x - y &= 1 \\ \underline{-2x} \quad \underline{-2x} \\ -y &= -2x + 1 \\ \underline{-1} \quad \underline{-1} \quad \underline{-1} \\ y &= 2x - 1 \end{aligned}$$

$$\begin{aligned} 3x + 4() &= 18 \\ 3x + 4(2x - 1) &= 18 \\ 3x + 8x - 4 &= 18 \\ 11x - 4 &= 18 \\ \underline{+4} \quad \underline{+4} \\ 11x &= 22 \\ \underline{11} \quad \underline{11} \\ x &= 2 \end{aligned}$$

$$\begin{aligned} 2() - y &= 1 \\ 2(2) - y &= 1 \\ 4 - y &= 1 \\ \underline{-4} \quad \underline{-4} \\ -y &= -3 \\ \underline{-1} \quad \underline{-1} \\ y &= 3 \end{aligned}$$

$$(2, 3)$$

$$6. \begin{aligned} 7x + 3y &= -16 \\ x - 2y &= 5 \end{aligned}$$

$$\begin{aligned} x - 2y &= 5 \\ \underline{+2y} \quad \underline{+2y} \\ x &= 2y + 5 \end{aligned}$$

$$\begin{aligned} 7() + 3y &= -16 \\ 7(2y + 5) + 3y &= -16 \\ 14y + 35 + 3y &= -16 \\ 14y + 3y + 35 &= -16 \\ 17y + 35 &= -16 \\ \underline{-35} \quad \underline{-35} \\ 17y &= -51 \\ \underline{17} \quad \underline{17} \\ y &= -3 \end{aligned}$$

$$\begin{aligned} x - 2() &= 5 \\ x - 2(-3) &= 5 \\ x + 6 &= 5 \\ \underline{-6} \quad \underline{-6} \\ x &= -1 \end{aligned}$$

$$(-1, -3)$$

$$7. \begin{aligned} 3x - y &= 4 \\ 6x - 2y &= 8 \end{aligned}$$

$$\begin{aligned} 3x - y &= 4 \\ \underline{-3x} \quad \underline{-3x} \\ -y &= -3x + 4 \\ \underline{-1} \quad \underline{-1} \quad \underline{-1} \\ y &= 3x - 4 \end{aligned}$$

$$\begin{aligned} 6x - 2() &= 8 \\ 6x - 2(3x - 4) &= 8 \\ 6x - 6x + 8 &= 8 \\ 0x + 8 &= 8 \\ 8 &= 8 \end{aligned}$$

Dependent
The lines are the same.

$$\begin{aligned} 8. \begin{aligned} 8x + y &= 31 \\ x &= -3 - 7y \end{aligned} \\ 8() + y &= 31 \\ 8(-3 - 7y) + y &= 31 \\ -24 - 56y + y &= 31 \\ -24 - 55y &= 31 \\ \underline{+24} \quad \underline{+24} \\ -55y &= 55 \\ \underline{-55} \quad \underline{-55} \\ y &= -1 \end{aligned}$$

$$\begin{aligned} x &= -3 - 7() \\ x &= -3 - 7(-1) \\ x &= -3 + 7 \\ x &= 4 \end{aligned}$$

$$(4, -1)$$

$$10. \begin{aligned} 3x + 4y &= 19 \\ 3x + 6y &= 33 \end{aligned}$$

$$\begin{aligned} 3x + 6y &= 33 \\ \underline{-6y} \quad \underline{-6y} \\ 3x &= 33 - 6y \\ \underline{3} \quad \underline{3} \quad \underline{3} \\ x &= 11 - 2y \end{aligned}$$

$$\begin{aligned} 3() + 4y &= 19 \\ 3(11 - 2y) + 4y &= 19 \\ 33 - 6y + 4y &= 19 \\ 33 - 2y &= 19 \\ \underline{-33} \quad \underline{-33} \\ -2y &= -14 \\ \underline{-2} \quad \underline{-2} \\ y &= 7 \end{aligned}$$

$$\begin{aligned} 3x + 4() &= 19 \\ 3x + 4(7) &= 19 \\ 3x + 28 &= 19 \\ \underline{-28} \quad \underline{-28} \\ 3x &= -9 \\ \underline{3} \quad \underline{3} \\ x &= -3 \end{aligned}$$

$$(-3, 7)$$

$$9. \begin{aligned} 2x + y &= 42 \\ x &= 10y \end{aligned}$$

$$\begin{aligned} 2() + y &= 42 \\ 2(10y) + y &= 42 \\ 20y + y &= 42 \\ 21y &= 42 \\ \underline{21} \quad \underline{21} \\ y &= 2 \end{aligned}$$

$$\begin{aligned} x &= 10() \\ x &= 10(2) \\ x &= 20 \end{aligned}$$

$$(20, 2)$$